

## NOTES ON THE FEMALE COLOUR FORMS OF *SYNTHEMIS MIRANDA* SELYS, 1871 (ODONATA: SYNTHEMISTIDAE) IN NEW CALEDONIA

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### Abstract

Two female *Synthemis miranda* Selys specimens with strikingly different morphological features (mainly wing colouration) were collected in sympatry in Province Nord, New Caledonia. Both appear to be mature adults. Specimens with these two colour patterns have previously been reported in the literature but this paper presents the first record of their co-existence. We formally recognise the two forms based on colour pattern and note other morphological features that may also distinguish them. The validity of these additional characters requires confirmation through examination of further material.

### Introduction

*Synthemis miranda* Selys, 1871 has often been referred to as the finest, most interesting and spectacular species of the genus *Synthemis* Selys (Tillyard 1910, Campion 1921, Lieftinck 1971, Davies 2002). It is also one of the most controversial species of the genus. The type locality has been extensively debated because, in the original description, Selys (1871) did not specify precisely where the female holotype originated. His statement 'Patrie: Nouvelle-Calédonie, par feu le père Montrouzier. (Coll. Selys.)' is also misleading because it is unclear who should be credited with the discovery of the species. The situation became even more complicated when Tillyard (1910) presented an anecdote about the discovery of the species. According to him, the holotype was spotted by Selys pinned on a lady's hat in a fashion shop in Paris. The origin of this story is unclear, but most probably it was a rumour swirling around at that time and Tillyard had heard it from René Martin in Paris. However, in the two large works (Martin 1906, 1914) preceding and following Tillyard (1910), no details were given about the discovery of *S. miranda*.

Martin (1906) illustrated the wing venation and colouration of the holotype and Martin (1914) provided only a short note about the general distribution of the species (as 'Nouvelle-Calédonie'). Ris (1915) and Schmidt (1938) commented on the validity of Tillyard's (1910) anecdote, concluding that it was erroneous and probably arose because of uncertainties about the origin of the species in the original description. However, Davies (2002) repeated this story, claiming that the species was named after its discovery in the shop in Paris and '... it was many years before its actual home was discovered to be Melanesia'. Such stories, although intriguing, do little to advance our knowledge of this species. Although the type locality is not certain and probably never will be, the general origin of the species (Nouvelle-

Calédonie) was given in the first description and its occurrence as an endemic species there has been confirmed by other researchers.

The species' wing colouration is the second most discussed point in the literature. The combination of bright yellow and brown occupying a large area of the wing gives *S. miranda* a striking appearance. Campion (1921) was the first to report that the extent of this colour is variable. Among the insects collected from New Caledonia by Mr Paul D. Montague, there were two males and three females. This material formed the basis of the description of the [met]allotype male and a brief introduction to variation in the extent of wing colouration in females. These females were collected on the same date and all had limited colour that did not extend beyond the arculus, unlike the holotype which has substantially more extensive colour on the wings. It is also important to note that one female was immature while the two others were fully mature.

Lieftinck (1971) was the next author to report females of *S. miranda* with reduced colour on the wings and the first who suggested that '... it would appear that there are two main forms of female, which differ markedly from one another as far as the wing colour is concerned, evidently quite independent from the age of the individual, intermediates occurring at the same time, though apparently more rarely'. However, no names for these forms were proposed. He did not report the total number of specimens investigated and, with the exception of seven specimens retained in the Netherlands, the material was returned to the Bishop Museum in Hawaii. Most of these seven females were collected from different locations; only two were from the same site – Pouébo, in the northeastern part of the country. One of those specimens had a wing colouration intermediate between that reported for the holotype and the reduced colour, but it is unclear to which form the second specimen from that location belongs. No further comments on this issue were presented in two subsequent studies by the same author dedicated to the Odonata of New Caledonia (Lieftinck 1975, 1976); he had examined additional imagines without specifying the type of wing colouration they possessed and regarded the wing venation (rather than colouration) as a more important taxonomic feature (Lieftinck 1976).

Reduced extent of wing colouration was reported in all 12 females that emerged during a larval rearing experiment (Winstanley 1983). No females with extensive colouration similar to the holotype emerged during that study. Davies' (2002) claim to priority of the discovery of females with reduced wing colouration is therefore incorrect. Davies (2002) referred to these specimens as 'unusual style' females but provided no specific description or a name in his otherwise very detailed review of New Caledonian odonates. Unfortunately, it is difficult to determine from Davies' illustrations the full extent of pigmentation on the wings. Apparently, he considered those females to have an atypical colouration rather than being a distinct form, although on

one occasion he observed many '... properly mature ...' individuals with this kind of colouration flying together with males. Formal description of the two female types has never been suggested in the literature and the most likely explanation is the fact that so far both types have never been collected from the same site.

A recent biodiversity survey in New Caledonia documented females with both types of wing colouration at the same location. This appears to be the first record of sympatry reported for these types and we believe it will be useful for future workers to describe and formally recognise them as distinct forms. Our morphological analysis also hinted that additional features may distinguish the 'unusual' form from the typical (*i.e.* holotype) form. The names we suggest here are provided for convenience and to help avoid any further misinterpretations pertaining to the different forms of this interesting species.

### Material and methods

The material analysed here was obtained during Conservation International's Rapid Assessment Program biodiversity survey carried out around Mt Panié, New Caledonia. The study area was sampled on two occasions: 10-21 October 2010 (MM) and 01-15 November 2010 (SR). Females of the two colour forms were encountered during the second period only. They were compared with earlier descriptions in the literature, their affiliation verified using the figures provided by previous researchers and names assigned to the two forms.

Abbreviation of the wing venation follows Theischinger and Hawking (2006).

### Systematics

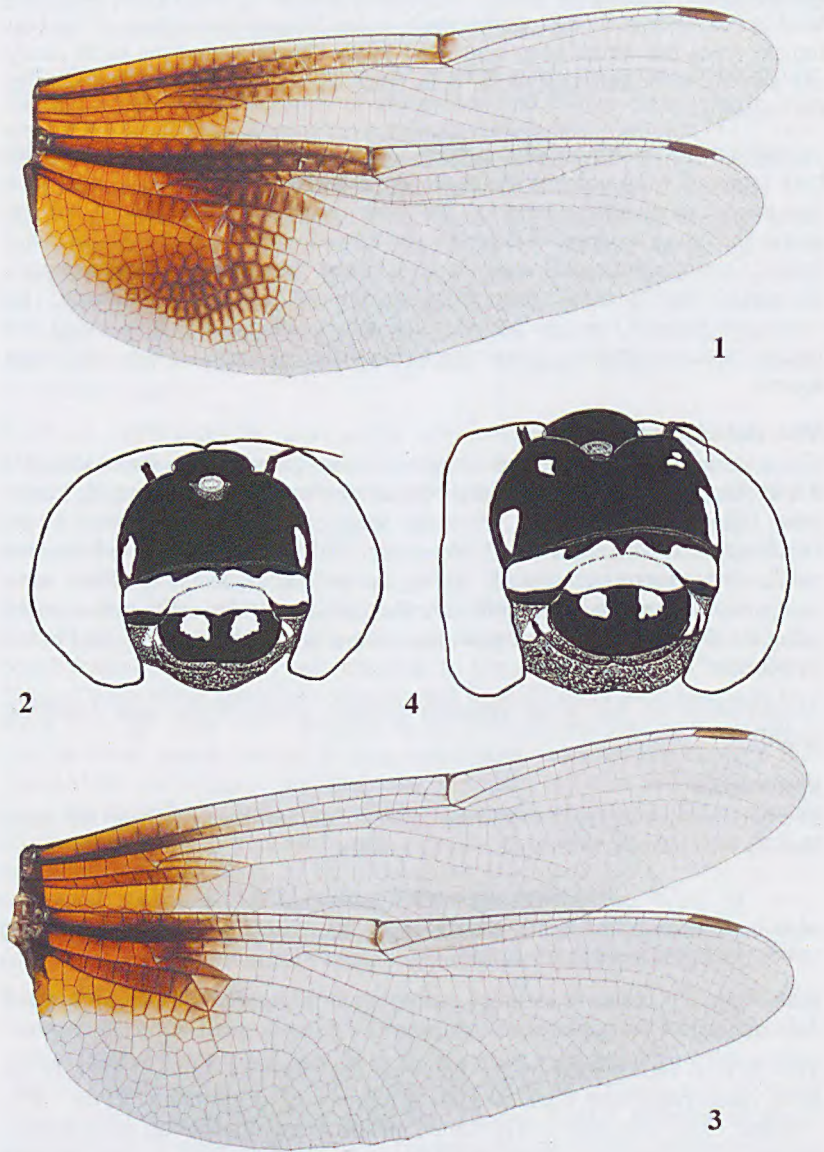
The two females reported here were collected on the same day from the same locality (see below). Both appear to be mature.

#### *Synthemis miranda* f. *typica* (Figs 1-2)

*Material examined.* NEW CALEDONIA: 1 ♀, Dawenia Camp (20°32'15"S, 164°40'50"E, 586 m a.s.l.), 15.xi.2010.

*Etymology.* The name is assigned according to priority of the description and does not reflect the apparent abundances of the two forms.

This form is represented by the holotype described by Selys (1871). It has been redescribed and illustrated on a number of occasions (Martin 1906, Tillyard 1910, Campion 1921), which makes a new description unnecessary. Figure 1 illustrates the extent of colour on the wings of the female reported here. The pattern is similar to that of the holotype. In addition to the extent of colouration the following features, which were not described by previous researchers, may prove useful in future for distinguishing form *typica* from the form described below.



Figs 1-4. *Synthemis miranda* females. (1-2) f. typica: (1) wings; (2) head. (3-4) f. extenuata: (3) wings; (4) head.

Head (Fig. 2): Mandibles reddish brown with darker colour at the bases and a white vertical bar at the level of the lateral edge of labrum. Clypeus is not whitish as given in Campion (1921). A black margin borders almost the entire postclypeus. It is broader at the anterolateral edges and central posterior area and narrows towards and along the eyes and then continues upwards along the borders with the anteclypeus, with the black bars not meeting on the very top section of this border line. A weak, roughly triangular black mark extends ventrally from the central part of posterior edge of postclypeus, with its tip pointing towards anteclypeus. Slightly darker areas are also present on the anterolateral corners of anteclypeus.

Abdomen with a pair of white ventrolateral spots present on both sides of S1 and a characteristic white ventral edge on each side of S2 to S8. Campion (1921) reported supplementary basal spots on S5, a feature not included in the original description of the holotype. They are, however, clearly visible on the specimen reported here.

Measurements (mm). Total length (with appendages) 68.7; abdomen (with appendages) 55.4; forewing length 49.4; hindwing length 48.5.

*Synthemis miranda* f. *extenuata* (Figs 3-4)

*Material examined.* NEW CALEDONIA: 1 ♀, Dawenia Camp (20°32'15"S, 164°40'50"E, 586 m a.s.l.), 15.xi.2010.

*Etymology.* The name translates from the Latin for alleviated, reduced or thinned out (H. Fliedner pers. comm.) and refers to the reduced colouration on the wing area compared with the holotype.

The most notable difference of this form is the extent of colouration on the wings. Other potentially important characters involve colouration of the clypeus, frons and abdomen but they are weakly expressed and it is not clear if they are features typical of the form or are just morphological variation. Those characters are described following the description of the wings. Other morphological features that have already been introduced in the literature were found to be nearly the same as the holotype.

Wings (Fig. 3): Tinged with brown at the bases of both pairs. The colour is deeper along the main longitudinal veins and fades on the wing membrane to opaque yellow. It is much darker in the area between Sc and R1 in both pairs of wings. In the forewings the brown area occupies the total length of the Ax6 with some patchy signs of colour in subcostal space between Ax9-10. The colouration extends posteriorly to the anal margin with the wing membrane becoming more diffuse yellow with light brownish touches along the transverse veins. The colouration occupies the entire hypertriangle and cubital space. Subtriangle is free of colour. Weak diffuse brown marks are developed along the nodus, more intensively at the proximal end of the Sc; they do not continue on the subnodus. In the hind wings the colouration is developed as follows: the subcostal space is the darkest area; opaque yellow

becomes a diffuse brownish around Ax4-5 and continues until Ax7-8; very weak patches are still present on the cells between Ax9-10 also; the colouration completely covers the sector of arculus, hypertriangle, triangle and cubital space and continues posteriorly to the level of the top rows of cells of the three divisions of the anal loop (middle to the posterior end of second row in proximal and middle divisions and only first row in the distal division); the brown continues along the anal vein up to the point where it joins CuP; weak diffused brown follows the CuP for a very short distance after this joins at about the level of the first cell formed at the division of CuP and 1A and also goes one more cell distance along 1A; nodal area is marked on the same manner as the forewings, with the brown forming an almost elliptical spot. Scattered diffused brown spots occur at several other places on the wing membrane.

Head (Fig. 4): Black colouration of clypeus generally resembles the pattern described above for *f. typica* but with projections into the whitish area much more marked. Two additional white spots (one divided by a transverse dark bar) are developed on the top area of the frons.

Abdomen with no supplementary basal spots on S5. The base of S5 on the single investigated female is slightly retracted into S4, which obscures clear vision of this part of the abdomen and this feature needs further verification.

Measurements (mm). Total length (with appendages) 69.3; abdomen (with appendages) 59.4; forewing length 48.3; hindwing length 47.5.

### Discussion

This paper presents the first evidence for co-existence of female *S. miranda* with strikingly different wing colouration pattern and we formally refer them to two separate forms to aid future discussion of this species. Although the present descriptions are based on two females only, there are multiple data in the literature indicating that wing colouration is not related to the state of maturity and this is the first record of sympatry of the same aged (mature) females collected on the same day. Variation in the extent of wing colour was also found by Campion (1921) and Davies (2002), who reported it extending only as far as the level of arculus, which is shorter than in *f. extenuata* described here. Also, Lieftinck (1971) reported a specimen with colouration extent intermediate between *f. typica* and *f. extenuata*. Variations at the infraspecific level are common and were, for example, encountered in a very extensive survey on female polymorphism in Odonata (Fincke *et al.* 2005). That study reported difficulty in assigning some females to a particular form because of phenotypic variations in otherwise unequivocally andromorph and heteromorph females. They proposed that female polymorphism must be heritable in order to be considered as genetic and designated the term 'functional polymorphism' to describe genetically monomorphic females with colour states which are age dependant. It is evident, from previous

literature records and present observations, that the wing colour in *S. miranda* is not influenced by state of maturation and thus is probably inherited.

More evidence is needed to determine whether the other morphological features mentioned here as potentially diagnostic are useful because our observations are based on single specimens. Further morphological research is also necessary to determine whether the additional differences described here are age dependant, inheritable or vary between populations.

Future identification keys should consider both forms. Lieftinck (1971) provided the only key to New Caledonian species of *Synthemis* which, if followed precisely, may not identify the holotype female. It gives the wing colouration extending only as far as the arculus, which is typical of *f. extenuata*, whereas the dark area in *f. typica* extends beyond the nodus.

*Synthemis miranda* is a common species (Davies 2002) and future investigations will hopefully provide more data about the abundance of and ratio between the two female colour forms. The names suggested here are proposed for convenience in subsequent interpretations of the results from odonatological studies in New Caledonia. The names may not reflect the true ratio between both female forms and have no formal standing under the International Code of Zoological Nomenclature. So far it is not clear if the so called *f. typica* is really the typical (dominant, most common or often encountered) of the two. The name is assigned by priority as this form was the first to be described for the species. It is evident that females with both types of wing colouration are commonly encountered among the insect samples from the country. A quick scan through the literature revealed five records of *f. typica* and 18 records of *f. extenuata*. This is simply an account of the published data and in no case proves the dominance of one form over the other. Researchers do not always report on the type of females examined during their studies, nor on the number of specimens examined. For example, Lieftinck (1971) examined a large collection but reported only on a subset (six males and six females) of this material and neither Lieftinck (1975) nor Davies (2002) gave any indication of the total number of females that they examined.

### Acknowledgements

We thank our local guides for providing us with the best possible assistance in the field and for kindly hosting us on their land. Our special gratitude goes to the organisers of the 2010 New Caledonia RAP, particularly to François Tron and Romain Franquet but also to the whole Conservation International-New Caledonia staff, their partner organisation Dayu Biik, and J.J. Cassan of Province Nord. We also thank Vincent Kalkman for the important suggestions and comments made on early drafts of the paper, Heinrich Fliedner for consultation on the scientific name of the newly described female form and Matt Walter for providing photos of the wing colouration.

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